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PRELIMINARY OPERATIONAL REQUIREMENTS AND ACCEPTABILITY CRITERIA FOR THE COOPERATIVE BREATH ANALYZER

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SEPTEMBER 1971
TECHNICAL REPORT

Prepared for:
DEPARTMENT OF TRANSPORTATION
TRANSPORTATION SYSTEMS CENTER
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The opinions, findings, and conclusions expressed in this publication are those of the authors and not necessarily those of the National Highway Traffic Safety Administration.

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15. Supplementary Notes

16. Abstract

This report presents a series of criteria and requirements relevant to establishing user acceptability for the cooperative alcohol analyzer being developed by the Transportation Systems Center.

The information presented herein was obtained with the cooperation of police officials, judicial personnel, Alcohol Safety Action Project (ASAP) officials and government officials

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SUMMARY

This report presents a series of criteria and requirements relevant to the Analyzer's acceptability as perceived by potential users. The major conclusions to be drawn may be summarized as follows:

- The Analyzer is expected to find a great deal of use as a field screening device. An increasing number of law enforcement agencies plan to conduct such screening tests as a means of enhancing the officer's judgment as to whether or not the suspect has violated a drinking driving ordinance. Significantly, relatively few (and minor) design modifications would be required to prepare the instrument for this application, assuming design goals regarding reliability, maintainability and accuracy are satisfied.

- In order for the Analyzer to prove useful for evidential purposes, its configuration faces significant modification and it must be compatible with a number of procedural requirements. These factors do not arise primarily from any engineering deficiencies; instead they relate to points of protocol imposed by the judicial system upon devices used to gather evidence.

- The Analyzer will probably prove least applicable as a field-evidential device, simply because very few police departments have any need for conducting evidential tests at the site of an arrest. In most cases, suspects can easily be transported to a police station and tested on a stationary Breathalyzer or Intoximeter within an acceptable time span. Moreover, law enforcement officials hesitate to submit evidence obtained under "uncontrolled" conditions since they consider it extremely susceptible to challenge.

The material presented herein served as a basic input for the development of Analyzer field test plans. Accordingly, this report should be considered a companion to Field Test Plan for Evaluating the Cooperative Breath Analyzer, which is being submitted concurrently.

I. INTRODUCTION

This report, submitted to the U. S. Department of Transportation, Transportation Systems Center, under Contract Number DOT-TSC-251, documents preliminary operational requirements and acceptability criteria pertaining to the cooperative Breath Analyzer. These requirements and criteria were identified by Dunlap and Associates, Inc. as a prerequisite for developing the Analyzer field test plan. It is expected that additional information will be obtained in these areas during the conduct of subsequent tasks under this contract. However, in view of TSC's continuing developmental effort, it is worthwhile to report at this time on the information presently available. Specifically, this report is motivated by the facts that:

- Recommendations for field testing the Analyzer are being submitted to TSC concurrently with this report. The instruments fabricated for testing should be designed to satisfy all essential requirements and criteria to avoid costly and time-consuming evaluation of an unacceptable version of the Analyzer.

- TSC is presently evaluating a number of different Analyzer models. Timely inputs of the information uncovered thus far should facilitate assessment of the relative merits of each.

- It has become apparent that certain legal steps must be taken before the Analyzer can be put to fully operational use--such steps might even be required to permit field testing. Since these legal procedures tend to be time-consuming, requirements in this area should be brought to the government's attention as quickly as possible.

Much of the information presented herein was obtained by Dunlap and Associates, Inc. through a series of discussions with police officials, judicial personnel, and Alcohol Safety Action Project (ASAP) officials. The agencies contacted included:

- The Office of the District Attorney, Nasau County, New York
- The Highway Patrol Bureau of the Nassau County Police Department
- The Boston (Massachusetts) ASAP

- Meteropolitan District Commission Police Department (Boston)
- The Vermont ASAP
- Vermont State Police
- The New Hampshire ASAP
- The New Orleans (Louisiana) ASAP
- New Orleans Police Department
- Baton Rouge (Louisiana) Police Department
- Louisiana State Police
- The Columbus (Georgia) ASAP
- Columbus Police Department
- The Indianapolis (Indiana) ASAP
- Canadian Ministry of Transport
- Royal Canadian Mounted Police

Without the cooperation of these organizations, this report could not have been written.

II. CRITERIA AND REQUIREMENTS

The wide-spread use of breath testing equipment during the past two decades has given rise to a wealth of knowledge concerning the requirements which such devices must satisfy in order to prove judicially acceptable. Some of these requirements stem from the particular laws and regulations of individual jurisdictions (and hence are only locally relevant); others are recognized as essential in virtually every state. During discussions held with numerous ASAPs and police departments in preparation for planning the Analyzer field test, many such requirements--of both local and national relevance--were uncovered. This section documents these findings, which have been grouped into the following broad categories:

- Equipment design and configuration
- Operational considerations
- General comments and observations

Before presenting the specific information obtained, it should be emphasized that most of the points noted relate to the use of the Analyzer as an evidence-producing instrument. Police officers and prosecuting attorneys have found that juries--and to some extent even judges--are extremely reluctant to convict on the basis of information derived from a "black box." Great care therefore must be taken to insure that the "chain of evidence" is maintained. That is, the prosecution takes pains to show, through documentary exhibits and unimpeachable testimony, that the instrument in question:

- Was functioning properly
- Was operated correctly*
- Was actually applied to test the defendant

To the design engineer, some of the configuration and procedural factors discussed below may appear needlessly redundant. However, law enforcement and judicial personnel feel they are essential to construct and strengthen this evidential chain. In large measure the ultimate acceptability of the Analyzer as a means of securing convictions will hinge upon the extent to which its design and operation account for these factors.

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*Often, this testimony and evidence relates to the adequacy of the instrument's operator as much as to the device itself.

On the other hand, many of the requirements sugggested by potential users would not apply if the Analyzer were used only as a field screening instrument. In fact, a number of police officers stated that they could use the Analyzer "as is" in this application. Most of the points discussed below should therefore be considered ultimate goals rather than areas for immediate modification, except where it is indicated that they apply to screening as well. Nevertheless, to achieve maximum benefit from the field tests, the prototype instruments should reflect as many of these factors as possible.

A. Equipment Design and Configuration

This paragraph itemizes specific hardware modifications which potential users see as required to enhance the effectiveness of the Analyzer. It should be emphasized that the remarks discussed herein are based upon the Analyzer configuration as depicted in the wooden mock-up furnished to Dunlap and Associates, Inc. by TSC. Since this configuration is undergoing almost continuous change, some of these topics may be of historical value only. Moreover, any attempt to specify an optimum design at this time would be premature since the field tests will undoubtedly uncover additional need for modifications. Nevertheless, it is worthwhile to document the design features suggested by law enforcement, judicial, and ASAP personnel since they reflect functional capabilities desired by these potential users.

1. "Hard Copy" Output

It is significant that the first point mentioned by almost every individual contacted was the need to obtain recorded output from the Analyzer. This "hard copy" is considered the key link in the chain of evidence. While some currently accepted instruments (e.g., the Breathalyzer) require the operator to generate the printed output manually, it is generally agreed that the Analyzer's reading should be recorded and produced automatically to guarantee against deliberate or accidental tampering of evidence.

The only datum that must be included in the print-out is the suspect's blood alcohol equivalent (BAQ). However, it would be desirable if the date and time could also be automatically recorded, as well as the suspect's driver's license number.

During the course of the discussions, project staff members described two approaches which could be taken to satisfy the need for recorded output. These were:

- A manually-selectable printer, electronically interlocked with the two-digit display. That is, the officer would dial in the reading to be printed, but output would be produced only when the selected value agreed with the reading actually obtained.

- A photographic system with "immediate" output (i.e., Polaroid-type).

The first approach was considered acceptable universally. The second also was deemed feasible, provided the camera system were an integral component of the Analyzer. As might be expected, recorded output is not mandatory for the field screening application, although it is considered desirable.

2. Indication of Breath Passage

For any application, the Analyzer must incorporate some means of indicating that the suspect is actually providing a breath sample and is exhaling with sufficient force. Persons arrested for drinking driving often attempt to "fool" the breath testing instrument by holding their breath while exhibiting all outward signs of compliance (puffing cheeks, etc.). Some mention was made of the possibility of incorporating a whistle in the mouthpiece to provide this indication. However, this would have the disadvantage of forcing the officer to judge whether or not the breath was being expelled with sufficient force. The police suggested that a better approach would be to provide an indicator light which would illuminate only when the requisite pressure threshold is met or exceeded.

3. Breath Pressure Regulator

When informed that the Analyzer's accuracy might be affected by the flow rate of the breath sample, the personnel contacted stated that there would have to be some means of regulating pressure. The solution most often suggested was to provide a breath entrapment chamber similar to those used in the Breathalyzer and Photoelectric Intoximeter; once the chamber is filled, a piston could be used to drive the breath through the fuel cell at a fixed rate.

This approach seems undesirable since it almost certainly would increase the size of the Analyzer and necessitate purging of the chamber before each test is conducted. An appropriately designed mouthpiece and intake orifice would probably suffice to keep the flow rate within acceptable bounds.

4. Temperature Indicator

Through their experience with current devices, the police have learned that measurements will err if breath alcohol is allowed to condense on the instrument's internal surfaces. They are aware that this problem is overcome if the device is pre-heated to a sufficient temperature (generally accepted as 50°C).

It is expected that the Analyzer's accuracy will also be temperature sensitive, and that its operation will require a similar delay for warm-up. It is therefore essential that an indicator be furnished to show that the desired temperature has been achieved.

5. Provision for Multiple Samples

In the State of Vermont, each time a chemical test is conducted for evidential purposes, the police legally are required to retain a sample of the test substance for sixty days. At any time during this period, the suspect can request the sample for purposes of obtaining an independent analysis. When blood or urine tests are conducted, this requirement can be satisfied easily, since a sufficient amount of fluid is extracted for multiple analyses. The restriction does, however, impose special requirements upon breath testing instruments. In effect, any such device must simultaneously furnish two breath samples, one of which can be analyzed immediately and the other (or at least its alcohol content) retained in an appropriate vial. It is precisely because of this restriction that the Vermont State Police employ the Photoelectric Intoximeter, which incorporates two separate sample chambers. One of these chambers is routinely "bled off" through a perchlorate tube which entraps the alcohol for subsequent analysis.

Vermont is the only jurisidiction (uncovered thus far) in which this capability is legally required. However, it is considered a desirable feature in many other locations. For example, the Louisiana State Police take advantage of the Photoelectric Intoximeter's ability to retain a breath sample in assessing the qualifications of the State's breath examiner specialists. They periodically furnish each operator with a perchlorate tube and instruct him to attach it to his PEI the next time he administers a test. If the BAQ measurement obtained by the operator does not agree closely with the subsequent analysis of the perchlorate, he is required to attend a refresher training course.

It is therefore evident that the Analyzer's attractiveness might be enhanced if it were provided with a multiple sampling capability similar to that exhibited by the PEI. However, this should be considered a relatively long-term goal since very few potential users perceive it as an essential requirement.

6. Maintenance of "In Transit" Temperature

Some concern was evidenced over the fact that pre-test heating of the fuel cell would be accomplished on battery power. It was felt that this might "drain" the batteries rapidly and necessitate frequent replacement, particularly when the Analyzer is employed in relatively cold climates. Several of the individuals contacted suggested that the instrument should be designed to operate off the patrol car's electrical system, at least for warm-up. If this is possible, it would be desirable to keep the Analyzer "plugged in" during transit (e.g., through the cigarette lighter receptable) to keep the fuel cell at an intermediate temperature (say, 35° to 40°C). Thereafter, even if battery power is needed to conduct the test, the load required to achieve the 50°C operating temperature would be considerably reduced.

B. Operational Considerations

As a general introduction to the requirements voiced in this area, it should be remarked that there is a definite need for the Analyzer's operational procedures to be kept as simple as possible. This is one instance where it is hoped that the Analyzer will offer a significant advantage over existing breath testing devices. The police consider these other instruments somewhat cumbersome or difficult to operate. They have found that court cases are sometimes lost because the defense attorney is able to challenge the measurement's accuracy by casting doubt on the officer's ability to perform the lengthy series of tasks involved in conducting a test.

Operational simplicity is also required in the field screening application. In this case, it must be kept in mind that the police officer will have many duties other than conducting breath tests--in some jurisdictions, he might have occasion to use the Analyzer only once or twice per week. With such limited exposure, the officer could lose confidence in his ability to follow an extensive or involved set of procedures, and eventually might refrain from using the Analyzer entirely. This situation has in fact occurred with some police departments which have employed the relatively simple balloon-type screening instruments.

The Analyzer's operational procedures, then, should be constructed to:

- Facilitate maintenance of the chain of evidence
- Avoid successful challenge of the officer's capabilities
- Encourage use of the instrument

Specific points noted by potential users are discussed below.

1. Observation/Waiting Period

Currently accepted breath testing devices produce grossly inaccurate readings if BAQ measurements are taken shortly after the suspect has imbibed alcohol. This phenomenon arises from the presence of alcohol vapor in the suspect's mouth; as breath is expelled, it becomes contaminated by this vapor, thus inducing an erroneously high reading. Recent studies * have indicated that this contamination can last for at least twenty minutes after ingestion of a drink.

Most police departments have long recognized the need to insure that any mouth alcohol has dissipated before administering a breath test. As a result, a waiting period of fifteen to twenty minutes duration generally precedes the measurement. During this time, the suspect is kept under close observation; should he belch, regurgitate, or otherwise contaminate his mouth, the observation/waiting period must begin anew.

The Analyzer will also be subject to this type of inaccuracy, and any evidential reading it produces should be preceded by a delay of at least twenty minutes. When the instrument is located in a police station, this requirement poses no real problem since current procedures account for it. In field-evidential applications, however, the requirement is significant. Some police officers suggested that it might prove illegal to detain an individual at the site of the arrest for that period of time. The very fact that this is perceived as a problem, regardless of its actual impact, will reduce the attractiveness of the Analyzer as a means of obtaining evidence in the field.

For field screening purposes, an observation/waiting period is not a critical requirement. However, since the measurement obtained in this application will be used to facilitate the officer's judgment as to whether or not the suspect is impaired, it would be very desirable to provide a means of indicating the presence of contaminating factors. Dr. Robert Voas of the Office of Alcohol Countermeasures, U.S. Department of Transportation, has suggested that residual mouth alcohol might induce a radical change in the fuel cell's reaction time. If this proves true, it might be possible to detect that change and call it to the officer's attention through an appropriate display or indicator light. It must be emphasized, however, that such an indicator would not

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*See, for example, Spector, N.H., "Alcohol Breath Tests = Gross Errors in Current Methods of Measuring Alveolar Gas Concentrations," Science, Vol. 172, pp 57-59, 2 April 1971.

eliminate the need for a waiting period in evidential applications. The Implied Consent Laws adopted by most states require that an arrested driver submit to only a single chemical test. Thus, if the evidential test were not preceded by a waiting period, and the Analyzer indicated that the measurement was contaminated, the arresting officer would face the following dilemma:

- The reading would not be accepted as evidence.
- The suspect could legitimately refuse to submit to a second test.

While on the subject of possible contamination, it should be reported that virtually all police officers contacted voiced concern over the specificity of the Analyzer to alcohol. They pointed out that other breath substances (primarily Acetone) might also "trigger" the fuel cell. To be sure, these same substances can produce readings on, say, the Breathalyzer. However, alcohol reacts much more rapidly with that instrument's potassium dichromate solution than does Acetone--thus, its effect does not come into play if the analysis is completed quickly. It is hoped that there will exist a similar capability for separating out the effects of these contaminants from the Analyzer's readings.

2. Calibration Checks

Regardless of how well-accepted a given breath testing device might be, defense attorneys regularly challenge the assertion that the particular instrument was functioning properly at the time the test was administered. To overcome this challenge, almost every police department has adopted the procedure of conducting a calibration check in conjunction with every evidential test. Simulator solutions with known blood alcohol equivalents are used for this purpose, and the results of these tests are introduced as evidence together with the reading obtained from the suspect. Depending upon the specific police department involved, this check is conducted either before or after testing the suspect (or both, in some cases).

While there are many simulators commercially available, few are sufficiently portable for field-evidential use.* This fact will tend to reduce the Analyzer's attractiveness in that application.

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*A notable exception might be the Nalco breath-alcohol standard recently placed on the market by Intoximeter, Inc.

Pre- or post-test calibration checks do not appear necessary if the Analyzer is restricted to field screening. However, it certainly would be prudent in this case to conduct a test on a simulator at the beginning or end of each duty shift.

3. Operator's Check List

Just as calibration checks are conducted to document the fact that the instrument was functioning properly, the police officer regularly submits evidence that he performed all required tasks in the correct manner. To insure that this testimony is not challenged, most departments issue "standard operating procedure" check lists to every officer qualified to administer breath tests. These lists are tailored to the specific instrument in use and reflect the department's own procedures. A sample of such a list (used by the Baton Rouge, Louisiana, police) is presented in Figure 1.

As each test is conducted, the officer carefully follows the sequence of tasks cited in the check list, and fills in all appropriate data. The completed list is submitted to the prosecutor, who introduces it as evidence in court.

Eventually, a list of the type shown in Figure 1 must be developed for use with the Analyzer. The forthcoming laboratory and field tests should shed a great deal of light on the specific items which should be incorporated in the list.

4. Special Requirements for Test Conductors

For all potential applications, and especially for use as a field screening instrument, it is desirable that the Analyzer be sufficiently simple and straightforward in operation to permit virtually any police officer to be qualified in its use. In this sense, there should be no special requirements which candidate Analyzer operators must satisfy. However, a number of police departments contacted in preparation for this report restrict the use of their breath testing devices in a way which will impact directly on the field-evidential application. Briefly, these departments feel that the arresting officer, because of his intimate involvement in the case and corresponding "loss of objectivity," would be more susceptible to challenges in court than would an "unbiased" third party. As a result, they do not permit the arresting officer to conduct the evidential breath test. If the Analyzer is located in a station house, where other qualified operators presumably are available, this restriction poses no insurmountable problems. However, it certainly appears that field tests for evidential use could not be conducted by departments which have adopted this procedural safeguard.

Figure 1

PHOTO-ELECTRIC INTOXIMETER®
OPERATING RECORD

DPS 28-45

The experienced operator will be able to conduct a test without reference to printed instructions. However, it is ESSENTIAL that each test made for law enforcement purposes be recorded in the detail provided for below for use in court. Explanation and elaboration of each item can be found in the Training Manual.

SUBJECT TESTED _____

OPERATOR _____ DATE _____

WITNESS _____ TIME _____

FIRST SECTION: CALIBRATION CHECK

1. Both power switches on ☐. Galvanometer mechanically zeroed ☐.
2. Standard ampul of 0.000 g% value removed from case, wiped clean, shaken and placed in well. Button depressed and needle brought to center by means of KNOB K4 ☐.
3. Standard ampul of _____ g% value removed from case, wiped clean, shaken and placed in well. Standard ampul read: _____ g%.

SECOND SECTION: PREPARATION OF INSTRUMENT

4. Sampling assembly mounted on vent and valve to POSITION I ☐.
5. Temperature in green area (105-110°F) ☐.
6. With scale set at 0.000 g% and REFERENCE ampul in well, button was depressed and needle brought to center by means of KNOB K4 ☐.
7. Stock ampul gauged ☐, opened, wiped clean and placed in well.
8. Stock ampul read: _____ g% (zero correction; note plus or minus)
9. Bubbler tube and mouthpiece mounted ☐.

THIRD SECTION: SYSTEMS BLANK

10. Valve to POSITION IV ☐; bubbling stopped ☐; rods down ☐.
11. Ampul read (bubbler partly withdrawn): _____ g% (final correction).

FOURTH SECTION: SAMPLE COLLECTION

12. Shifted sampling assembly to take sample ☐. Bubbler tube reinserted ☐.
13. Valve to POSITION III ☐. Subject under observation 20 minutes ☐.
14. Breath sample was obtained according to operating instructions and the accepted sample met the following requirements: A deflated waste bag was used ☐. Sequence: waste bag filled ☐; indicator rods rose steadily ☐; rods fully up when valve was turned to POSITION IV ☐.

FIFTH SECTION: ALCOHOL DETERMINATION

15. Bubbling stopped ☐; rods down ☐. Bubbler tube removed and discarded ☐.
16. At this point the instrument was flushed by turning valve to POSITION I to fill the cylinders ☐; then to POSITION II to discharge cylinders through sampling assembly ☐; then back to POSITION I to fill cylinders ☐; then to POSITION IV to flush delivery tubes ☐.
17. First reading of ampul; _____ g%.
18. Scale zero checked with REFERENCE ampul (same as Item 6) ☐. IF it has changed, reset with KNOB K4. Re-read the test ampul 3-5 minutes after Item 15. Second reading of ampul _____ g%.
19. Power switches off and sampling assembly stored ☐. Ampul discarded ☐.

RESULTS:

Second reading of ampul (Item 18): _____ g%
Final correction (Item 11): _____ g%

BLOOD ALCOHOL CONCENTRATION: _____ g%

5. Amount of Breath Sample Required

Almost every police officer contacted voiced considerable concern regarding the length of time over which a suspect would have to exhale in order for the Analyzer to measure his BAQ. When informed that this might range up to ten seconds, the general reaction was that the instrument might not prove acceptable. The consensus of opinion was that this requirement could render the Implied Consent Law unenforceable. That is, a suspect could technically comply with the law, but could void the test simply by asserting that he had "run out of breath" before the necessary time had expired. Moreover, he subsequently would not have to submit to another chemical test since he had satisfied his legal requirements by complying in good faith.

While the police seemed to consider this a major problem, there are some indications that the issue may prove to be a "red herring." Some (and perhaps all) currently accepted instruments require breath to be expelled for at least ten seconds and, in certain cases, considerably beyond this. For example, the operational procedures specified for the Mark II Gas Chromatograph Intoximeter assume that a subject will continue to exhale for five to ten seconds after the initial portion of the breath sample has filled a 1300 cc waste bag.* Similarly, the Alco-Analyzer Gas Chromatograph requires up to ten seconds of uninterrupted breath. The negative reaction encountered throughout the discussions may well have been due to the fact that ten seconds "sounds" longer than it actually is.

There is, then, a definite possibility that the fuel cell's reaction time may already lie within acceptable bounds. However, attempts should certainly be made to reduce this further to enhance the instrument's acceptability.

6. Requirements for Purging the Instrument

Every currently-accepted breath testing instrument must be purged between successive tests to insure that measurement error is not introduced by the presence of residual alcohol vapor in the entrapment chambers or internal tubing. From a purely technical point of view, the Analyzer should not be susceptible to this problem, since:

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*"GCI Breath Alcohol Analyzer Mark II" Operator's Manual, Intoximeter, Inc., St. Louis, Missouri. Time requirements for essentially all existing devices are discussed in Basic Training Program for Breath Examiner Specialist--Instructor's Lesson Plan, a report submitted to the U. S. Department of Transportation by Dunlap and Associates, Inc.

- There will be very little (if any) tubing in which residual vapor can collect.

- The fuel cell is expected to consume (oxidize) all alcohol introduced into the Analyzer.

- Since breath is not entrapped but instead passes through the instrument, the very act of introducing the sample will serve to "purge" the Analyzer.

Nevertheless, the police are generally doubtful that judges and juries can be convinced of the validity of these arguments. They feel their case would be strengthened if they performed a formal purging process, regardless of whether or not it is technically required.

One very attractive method for satisfying this requirement would be to conduct the zero setting check after performing the calibration.* The introduction of a "clean air" sample would serve to purge any residual simulator solution vapor. Moreover, the zero reading subsequently obtained could be introduced as evidence that the purging was successfully completed.

C. General Comments and Observations

This paragraph presents a brief compilation of those comments which either do not fit neatly into the categories of equipment configuration or operational procedures or else apply only to the forthcoming field tests. They are included in this report to acquaint TSC with the total set of information obtained through the various visits undertaken by the project staff.

1. Overall Acceptability

The immediate reaction of essentially everyone contacted was that the Analyzer represents a state-of-the-art advancement in breath testing equipment. Its portability and simplicity were viewed as its greatest benefits, although the digital readout and projected unit cost of $200 to $300 also produced very favorable reaction. It is of interest to report that field screening was cited almost universally as the instrument's chief application. Some departments, in fact, would not even consider evidential use. To some extent, this feeling arises from a general hesitancy on the part of the police to "change horses in midstream."

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*Assuming, of course, that a subsequent zero adjustment would not destroy the calibration's validity.

Although they are not necessarily completely satisfied with the instruments presently in use, those devices finally have achieved judicial recognition and acceptability. The police are naturally reluctant to enter once more into the lengthy process of obtaining legal sanction for a new instrument.

2. Possibility of Error

The police do not expect the Analyzer (or any instrument) to be totally accurate, and are not greatly concerned with the various factors which may induce error. They are, however, absolutely insistent on one point: any measurement error, regardless of its cause, must be in the suspect's favor. The two-digit readout, in particular, must be truncated rather than rounded off (e.g., a measurement of 0.129 should be displayed as 0.12 not 0.13). Several officers, when discussing this topic, suggested that any "detectable" malfunction should cause the instrument simply to cease operating entirely rather than permitting an erroneous measurement.

3. Obtaining Legal Sanction

In many of the states visited, the Analyzer will have to be subjected to an independent program of evaluation before it can be approved for use by the police. The agency responsible for conducting such evaluation varies from state to state; for example, the State Police Applied Technology Branch performs this function in Louisiana. In most cases, of course, there is no immediate need to initiate the process of obtaining this approval. However, Dr. Herman Jones, Assistant Director of the Georgia State Crime Laboratory, has stated that he will not permit field testing of the Analyzer until he has an opportunity to observe a working model. Since the City of Columbus is recommended as one of the primary test sites, it is essential to comply with Dr. Jones' request as soon as possible.

4. Special Considerations for the Field Test

Several of the police departments which have agreed to participate in the field tests have recommended that two special design features be incorporated into the prototypes undergoing evaluation. The first (and most often cited) suggestion is to stamp the legend "EXPERIMENTAL = Not To Be Used In Evidence" on the face of the instrument. The officers feel that this would help to overcome any reluctance to participate on the part of test subjects during the Roadside and Arrest phases. The second recommendation--mentioned by those participating departments which will use the Analyzer to screen suspected drinking drivers--is to attach a removable cover over the readout in order to prevent the suspect from seeing the measurement results. Frankly, Dunlap and Associates, Inc. does not attach a great deal of importance to this latter point, since:

- It is doubtful that the suspect would understand the significance of the reading.

- There is little or nothing he can do about it in any case.

However, if this feature will help secure the cooperation of these departments, it is certainly well worth adopting.

III. FUNCTIONS AND PROCEDURES

The preceding section listed specific hardware and operational requirements perceived by potential users of the Analyzer. Such comments were presented in much the same manner as they were received by Dunlap and Associates, Inc. That is, the intent simply was to document the information as it was offered by law enforcement, judicial, and ASAP personnel and to stress the impact which these points will have on the instrument's acceptability.

In addition to soliciting the opinions of potential users, Dunlap and Associates, Inc. has performed an independent preliminary analysis of the Analyzer's functional and procedural requirements. To be sure, the comments discussed previously served as important inputs to this analysis; however, attention was also paid to the human engineering implications of design and operation.

The results of this analysis are presented below in Table I. Entries in the leading (left-hand) column correspond to the following Analyzer functions:

- Transport
- Set-Up
- Test Administration
- Acquisition of Results
- Shutdown

The other three columns indicate, respectively:

- Operational procedures required of the function in question
- Analyzer applications for which each procedure is required
- Design guidelines and implications derived from each procedure

Based upon the results of Dunlap's analysis and the comments elicited from potential users, a preliminary sketch of the Analyzer's "instrument panel" has been prepared. This is shown in Figure 2. While it is expected that this configuration will undergo considerable revision, it nevertheless represents one possible design incorporating all requirements identified thus far. It should prove helpful to refer to this sketch while reviewing the material presented in Table I.

Table 1.
Analysis of Analyzer Functional and Procedural Requirements

Function	Required Operational Procedures	Relevant Applications*	Design Guidelines and Implications
Transport	Secure in patrol car/van.	1, 3	Provide for straps or other securing mechanism.
	Protect from rough handling, shocks, etc.	1, 3	Casing should be rigid and durable.
	Protect and maintain cleanliness of displays, switches, dials, etc.	1, 2, 3	Provide a removable (but secure) cover.
	Maintain "in transit" temperature.	1, 3	Provide for connection to vehicle's electrical system, e.g., through cigarette lighter receptacle.
	Carry to test location.	1, 3	Provide a handle.
Set-Up	Emplace for testing at various locations, e.g., on car seat, on car hood, suspended from window, on table, etc.	1, 2, 3	Provide rubber feet on the base of the instrument. and hooks on the back to permit suspension.
	Energize instrument.	1, 2, 3	To guard against human error and insure operational simplicity, all activities such as this should correspond to positions on a rotary switch. To energize the instrument, the operator would turn the switch to the ON position, the first position on this rotary switch.
	Verify that all indicators are functioning properly.	1, 2, 3	Provide a "lamp test" capability.
	Verify warm-up.	1, 2, 3	Provide an indicator light to signify that the fuel cell has attained the desired temperature (50°C). This indicator should be labelled READY.
	Check batteries.	1, 2, 3	This activity would correspond to the second position on the rotary switch. Properly-functioning batteries should cause the two-digit display to be energized.

*Coded as Follows:
1 - Field screening
2 - Stationary evidence-producing
3 - Field-evidential

Table 1. (Continued)

Function	Required Operational Procedures	Relevant Applications*	Design Guidelines and Implications
Set-Up (continued)	Check calibration setting.	2,.3	Provide a portable simulator; if possible, this should be incorporated within the analyzer itself. This activity would correspond to the third position on the rotary switch.
	Adjust calibration setting, if required.	2, 3	Provide for a tamper-proof adjustment, e.g., a locking knob. A screwdriver adjustment would be undesirable since it requires an additional tool that can be misplaced. This knob should be operable only when the rotary swit is in the CAL position.
	Purge analyzer/check zero setting.	2, 3	Provide a means of introducing a clean air sample into the analyzer. This activity would correspond to the next position on the rotary switch.
	Adjust zero setting, if required.	2, 3	See the previous comment regarding the adjustment of calibration setting.
	Attach mouthpiece to sample inlet.	1, 2, 3	Mouthpieces should be kept in individually-sealed disposable containers. Location of sample inlet should be based upon the following criteria: . Officer must be able to observe all displays and indicators while the subject is being tested. . Intake must be accessible to subject in sitting or standing position. . Handle, cover, switches, etc., should not block the intake.
Test Administration	Steady instrument and instruct subject to blow.	1, 2, 3,	Turn rotary switch to TEST position. If officer is required to steady the instrument, he should be able to do so with only one hand. Subject should not be permitted to place his hand on the instrument.

Table 1. (Continued)

Function	Required Operational Procedures	Relevant Applications*	Design Guidelines and Implications
Test Administration (continued)	Verify that subject is providing sample with sufficient force.	1, 2, 3	Provide pressure-sensing indicator light. It may also be desirable to incorporate a whistle into the mouthpiece so that officer can instruct the subject to "blow until the whistle stops," thus insuring a good sample of alveolar air. Indicator light should be labelled BREATH.
	Verify that sufficient sample has been collected for analysis.	1, 2, 3	Provide indicator light (labelled ANALYZE) to signify that instrument has automatically initiated analysis.
Acquisition of Results	Observe BAQ.	1, 2, 3	Provide a deigital display of reading obtained. To conserve batteries, the display should be energized only for a relatively short period of time. However, a pushbutton (labelled DISPLAY) should be provided to allow the officer to regenerate the reading.
	Document results.	2, 3	Provide a tamper-proof print out of the BAQ reading obtained and, if possible, the date, time, and subject's license number. (For screening purposes, it would suffice if the officer manually recorded the reading on a suitable form.) If it is necessary to manually initiate the print out, provide a pushbutton labelled PRINT.
Shutdown	Turn off instrument.	1, 2, 3	Last (OFF) position of rotary switch.
	Remove and dispose of mouthpiece.	1, 2, 3	Provide receptacle for used mouthpieces.
	Cover and stow mouthpiece.	1, 2, 3	

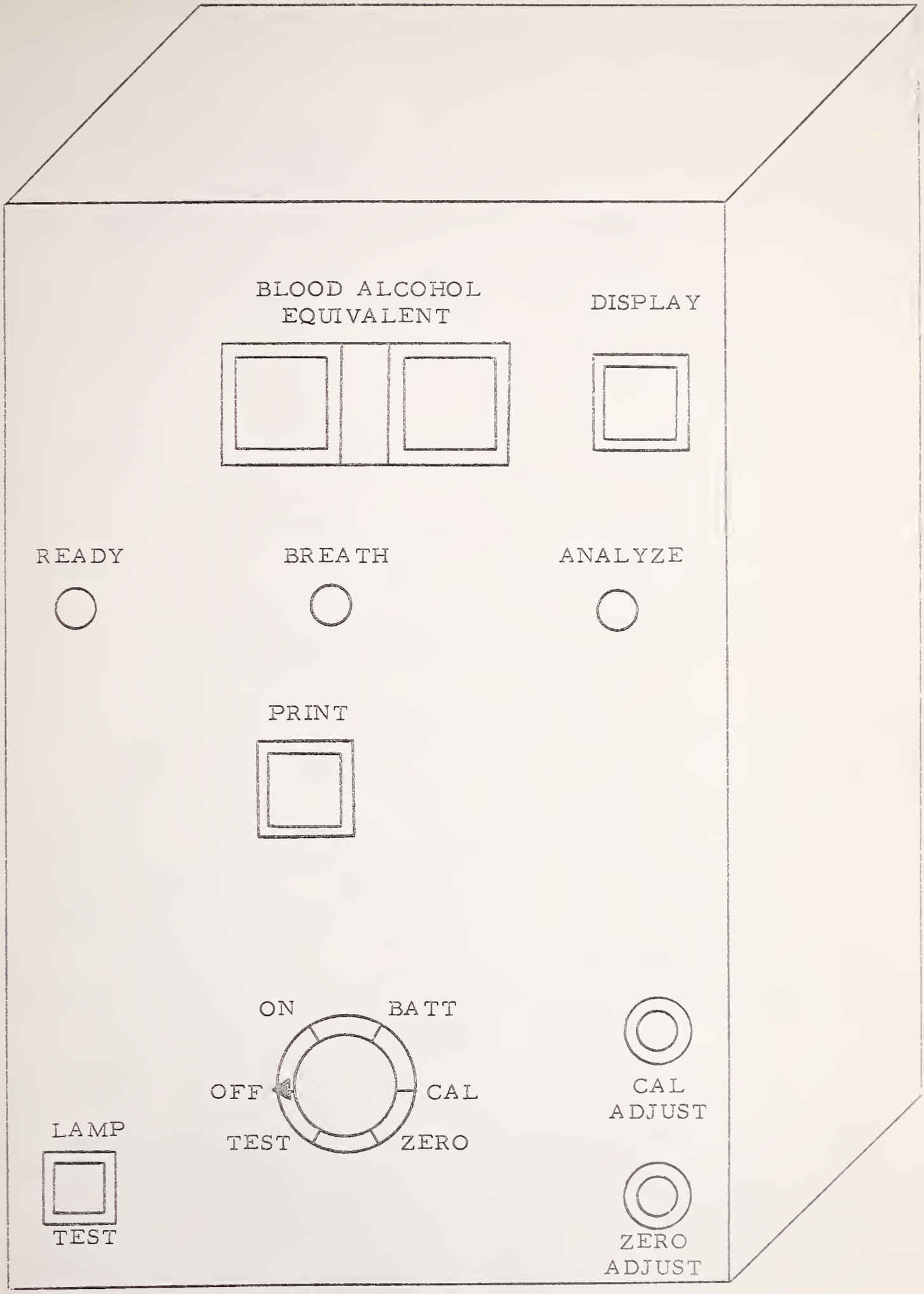

Figure 2. Analyzer Displays and Controls

While the topics covered in this report do not necessarily exhaust all requirements and criteria which the Analyzer must satisfy, it is doubtful that very much more information can be obtained at present through discussions with law enforcement or judicial personnel. * However, once the field tests are implemented and sufficient data are collected, it will be possible to specify the total set of criteria and requirements. In the coming months, the project staff accordingly will direct the bulk of their efforts toward identifying corresponding criteria relating to the Sniffer and Alcohol Safety Interlock Systems.

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*Nevertheless, Dunlap and Associates, Inc. will continue to attempt to elicit relevant comments from such individuals in the coming months, in conjunction with the performance of parallel tasks under this contract.

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